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OFFICE OF THE SECRETARY

March 23, 2000

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VIA HAND DELIVERY

Magalie Roman Salas, Esquire
Secretary

Federal Communications Commission
The Portals, 445 Twelfth Street, S.W.
Room TW-A325
Washington, DC 20554

Re: Petition of Lake Cedar Group, LLC for
Expedited Special Relief and
Declaratory Ruling

Dear Secretary Salas:

Transmitted herewith on behalf of Lake Cedar Group, LLC and each of its members, Group W/CBS Television Stations Partners, licensee of KCNC-TV; McGraw-Hill Broadcasting Company, Inc., licensee of KMGH-TV; Rocky Mountain Public Broadcasting Network, Inc., licensee of KRMA-TV; Twenver Broadcast, Inc., licensee of KTVD; and Gannett Colorado Broadcasting, Inc., licensee of KUSA-TV, all Denver, Colorado, are an original and four copies of the "Denver DTV Site Investigations Report" prepared by John F. X. Browne, P. E.. Please associate this Report with the above referenced petition.

Should any questions arise concerning this matter, please advise the undersigned.

Very truly yours,

Edward W. Hummers, Jr.
Counsel for
Lake Cedar Group, LLC

Enclosure



Denver DTV Site Investigations

Lake Cedar Group

Denver, CO

December 1999



Denver DTV Site Investigations

Lake Cedar Group

Denver, CO

This report addresses the results of studies undertaken by this firm for the Lake Cedar Group to identify possible sites for use by Denver area TV stations to construct their digital television (DTV) broadcast facilities. It is the latest in a series of reports prepared for the Lake Cedar Group which previously reported on site evaluation activities and summarizes / updates previously submitted data. The Federal Communications Commission (FCC) has mandated that these stations construct and operate these new facilities in accordance with a timetable which provides for a transition from present analog broadcasting to an all-digital system. During this transition, both existing and new facilities must be operated simultaneously.

Each broadcaster was assigned a new channel for DTV operation – all UHF channels in the Denver case. The FCC also assigned the operating power for each facility and specified that the DTV facility would be assumed to be operating from the site of its present analog facilities for the purposes of service replication and controlling interference to / from other stations; for most Denver stations, this is Lookout Mountain. While relocation may be technically possible, interference to other stations resulting from such a move is a limiting FCC consideration; solving such interference issues may require significant power reductions which, in-turn, will result in loss of service to the public; also, relocations which result in establishment of non-common sites for analog and DTV stations will pose receiving antenna orientation issues for viewers as discussed in more detail herein. For comparative purposes, Lookout Mountain is used as a baseline reference throughout this report since it is the site designated by the FCC for the DTV facilities of most stations.

The factors which must be considered in any evaluation of a proposed transmission site are discussed below. It is important to recognize that one of the major objectives of LCG in developing any site, including Lookout Mountain, is the consolidation of all digital broadcast facilities; such consolidation benefits the public by reducing substantially the visual impact (as compared with each station having its own tower ²¹, affording better control of radio frequency radiation (RFR – non-ionizing emissions from the facilities) ²² and optimizing the service to the public (essentially equal coverage and quality from all stations and reduced interference from stations operating on adjacent channels); the stations may also realize some cost savings resulting from combined operations. This benefits both the public and the station licensees.

Site Selection Criteria

The selection of a site which meets the objectives discussed above must also meet other requirements which are of a technical and regulatory nature.

Among the technical issues are the following:

Coverage – (How will the proposed facility permit stations to maximize their service to the public.)

Availability of Utilities – (The proposed facilities will consume a large amount of electrical power and proximity to high capacity power lines is essential.)

²¹ In addition to having a common tower for digital TV, some stations may be able to relocate their existing analog facilities to the new tower. This will permit the removal of some existing towers in some scenarios. At Lookout Mountain, for example, two towers could be removed immediately following construction of the new facility followed by at least two additional towers at the end of the transition period.

²² In the Lookout Mountain case, a significant reduction in RFR would result from the consolidation of FM stations on the new tower thus minimizing the major source of RFR presently affecting the site and area.

Access - (Existence of paved roads accessible in all weather conditions to facilitate construction, operation and maintenance.)

Proximity to Residential Areas - (Plans to develop a new site in an area where no - or few - towers presently exist can raise significant land use issues.)

Size of Site and Topography - (Adequate to support construction of "normal" tower implementation - including guy anchor radius and subsurface condition considerations.)

Development Costs - (Acquisition and infrastructure implementation including clearing, grading, power lines, roads and security provisions.)

Environmental - (Impact on nearby venues and residential areas, including RFR, visual impact and consequential results of clearing, grading, etc.)

Some of the regulatory factors which must be considered include:

Land Use & Zoning - (Non-compliance with land use plans or need for change in zoning or issuance of a variance are problematic.)

Local Code Compliance - (Effects of application of special building code provisions related to tower construction.)

FCC Regulatory/ Interference - (Facilities maximized for coverage purposes must comply with FCC mandates regarding interference; necessary power reductions to resolve interference will result in less coverage and service to the public.)^{2f}

FAA Clearances - (Impact of structure on safe and efficient use of the navigable airspace.)^{2f}

NEPA - (Implementation 1969 National Environmental Protection Act - compliance with FCC requirements including RFR limits.)

Table Mountain - (The Department of Commerce facilities at the Table Mountain Radio Receiving Zone are entitled to special protection from "interference" from broadcast facilities.)^{2f}

^{2f} There are three basic interference mechanisms which must be considered for DTV stations: interference to local DTV / NTSC stations on adjacent channels which cannot co-locate, interference to distant DTV stations, and interference to existing NTSC stations operating on any of 13 affected channels (UHF only). In addition, NTSC stations relocating to a new site must meet fixed "mileage" separations to other NTSC stations in order to demonstrate that no interference would be caused to existing or proposed NTSC facilities. Similar constraints would apply to any FM stations consolidating at a new site.

^{2f} As defined in Part 77 of the Federal Air Regulations, airspace utilization criteria as defined in TERPS (Terminal Instrument Procedures Manual) and electronic interference to FAA navigational and communications facilities as defined in the Airspace Analysis Model AAM 5.0.

^{2f} The protection requirements are spelled-out in 47 CFR Part 73. These requirements were adopted in the early 1980's post-dating the construction of most of the existing TV and FM stations. These pre-existing stations have been "grandfathered" at their present sites and facilities. Any relocation would require compliance with the new regulations and could result in major reductions in power / coverage depending on the proximity to Table Mountain. For example, all VHF TV stations and most FM stations operating from Lookout Mountain would be unable to comply with the requirements without using a directional antenna if the "grandfathering" provisions did not exist. See discussion which follows.

Table Mountain Radio Receiving Zone

The U.S. Department of Commerce (DOC), through its subsidiary entities such as National Telecommunications & Information Agency (NTIA) and Institute for Telecommunication Sciences (ITS), the National Oceanographic & Atmospheric Administration (NOAA) and the National Institute for Science & Technology (NIST), operates a research facility on an 1,800 acre tract northeast of Boulder. This facility is called the Table Mountain⁶⁷ Radio Receiving Zone (Table Mountain) and has been accorded certain rights by the FCC relative to protection from interference from all manner of radio transmission devices including broadcast stations and earth-orbiting satellites. (A technical discussion of the protection requirements is included in the Appendix.)

The FCC has established criteria for different types of facilities operating in various parts of the radio frequency spectrum. Presumably, these criteria protect the government-sponsored research activities at Table Mountain from objectionable interference from these external emitters. These criteria were put in-place in the early 1980's long after most of the Denver television and FM radio stations had been established on Lookout Mountain. All of the analog VHF TV stations (channels 2, 4, 6, 7, 9) were "grandfathered" as were several FM stations, i.e., they were not required to meet the then new protection standards. This "grandfathering" becomes a critical issue in a proposal to relocate facilities away from Lookout Mountain since any increase in signal level over Table Mountain would be impermissible.

Unfortunately, rules incorporating adjustments which recognize the different character of the digital signal have not been codified and present FCC / DOC policy is to address each proposal on a case-by-case basis.

⁶⁷ This should not be confused with the areas near Golden known as North Table Mountain and South Table Mountain.

A similar situation arises with respect to construction of the digital television stations. Taking a simplistic approach, wherein the differences in characteristics between the present analog signals and the new digital signals are not considered, all of the major TV stations would "violate" the technical standards regarding protection of Table Mountain. Following a year-long process of exploration and negotiation with the FCC and DOC / NIST, an agreement was reached to, in effect, extend the current grandfathering of the analog TV stations to the new companion DTV stations to be sited²⁷ on Lookout Mountain based, in part, on the digital signal characteristics. Any proposed relocation will require approval of the FCC and concurrence of DOC / NIST; if the signal levels over Table Mountain would increase, this approval is not likely to be forthcoming. The only technically feasible methods for mitigating this problem would be reduction in operating power or use of a directional antenna. Since the service area of a station is determined, in significant part, by the antenna radiation center height and power, reduction in either of these parameters has the effect of reducing service area. There are also design constraints which ultimately affect antenna performance (and, hence, signal quality) when directional antennas are employed and, therefore, broadcasters generally prefer not to use these antennas because of the compromised performance. One scenario where the use of directional antennas is less problematic is the case where there are few or no people in one or more quadrants of the service area such as a transmitter site situated near a large body of water (e.g., an ocean or one of the Great Lakes or a Gulf)²⁸.

Thus, for each alternative site considered for joint-use DTV broadcasting, a critical factor will be the impact on Table Mountain; assessment of the likelihood of obtaining timely approvals from the FCC and DOC will also be crucial in the decision-making process. For example, a DTV facility sited at Eldorado Mountain and operating with an FCC authorized power of 1,000 kW would exceed the maximum power permitted over Table Mountain by a

²⁷ The FCC in its coverage replication process allotted new Digital TV Channels based on use of the current Lookout Mountain site.

²⁸ Lookout Mountain has comparatively few people to the West. However, relocating to a site to the East would significantly alter that scenario.

factor of 87 times; stated another way, the operating power of the station would have to be reduced from 1,000 kW to 11.5 kW in order to comply with the basic FCC rules as presently formulated. Even if the DOC / NIST would permit a grandfathering status (whereby the power might be reduced to provide an equivalent ^{2/} signal level over Table Mountain), the power would have to be reduced from 1,000 kW to approximately 300 kW. Either of these scenarios would, of course, result in a significant reduction in the service that could be provided by a facility located on Eldorado Mountain.

Co-Location

One of the implied objectives of all telecommunications siting plans is that of consolidation, i.e., grouping all broadcast facilities at one site using as few towers as possible. LCG had proposed to locate all but two of the DTV stations in addition to all FM stations on a common tower. Initially, with the construction of the new tower, two existing towers would be removed and, at the end of the digital transition period, other towers on that site which presently support FM and TV antennas could be eliminated. It should be noted that it is unlikely that any towers would be removed from Lookout Mountain should an alternative site be selected for DTV build-out because relocation of existing facilities will be very problematic for the following reasons:

- Channel 6 TV-FM Interference - The tower presently supporting the antennas of KRMA-TV also supports the antennas for KUVQ-FM and KCFR-FM. These two FM stations must be co-located with Channel 6 to minimize interference. (The FM stations operate in the reserved, non-commercial portion of the FM band (88-92 MHz) which spectrum is immediately adjacent to TV Channel 6 (82-88 MHz). There is a high probability of interference to the reception of Channel 6 signals by the FM facilities; the FCC rules require co-location in these cases. [A more complete technical discussion of this issue is contained in the Appendix.]

^{2/} Equivalent to that produced by the grandfathered facilities on Lookout Mountain.

- TV Separations – The FCC established minimum mileage separation criteria for analog TV stations operating on the same channel and on adjacent channels. KCNC, Channel 4, is limited by these constraints by other stations in Scottsbluff, NE, and Grand Junction, CO. Depending upon the exact site selected, this could be a limitation. A waiver of the requirements could be sought but a grant by the FCC is far from guaranteed (but would be more likely in the case of Grand Junction due to the intervening terrain).
- Table Mountain – All present VHF stations on Lookout Mountain are grandfathered with respect to Table Mountain. Any relocation would affect this status and require compliance with existing FCC rules. Depending on the situation, this could result in loss of coverage and service to the public. (See preceding section on Table Mountain for more details.)

Therefore, "consolidation" or "co-location" does not necessarily mean that existing facilities will be (or can be) relocated to a new site where all (most) DTV facilities would be located ¹⁰⁷.

Another component of the co-location issue, which must be addressed in any site selection analysis, is the inter-channel interference between (among) stations operating on adjacent channels. In planning a digital station, consideration must be given to interference caused to other DTV stations operating on the adjacent channel above and below its channel. [Also, interference to analog stations on the four channels above and below the DTV channel (plus eight (8) other channel combinations) must be evaluated.] These adjacent-channel interference scenarios occur when the undesired signal is much stronger than the desired signal, a situation which exists when the adjacent-channel stations are separated by more than a few miles. ¹⁰⁸ The solution to this problem is to co-locate all facilities with adjacent-channel relationships so that any viewer receives nearly equal signals from all stations.

¹⁰⁷ Present FCC rules would permit stations to use their present channels for DTV at the end of the transition period. Thus, stations are permitted to elect to use existing facilities and sites as their "final" DTV facilities.

¹⁰⁸ For example, if stations are not co-located a viewer situated very close to one transmitter would receive interference from that transmitter when attempting to receive a signal from a distant adjacent channel station.

In Denver, for example, the following table of FCC allotments indicates the nature of the adjacent-channel problem for the facilities on Lookout Mountain.

<u>Station</u>	<u>Channel</u>	<u>Comment</u>
KUSA-DT	16	
KMGH-DT	17	
KRMA-DT	18	
KTVD-DT	19	
KTVD-TV	20	Now on Mt. Morrison (Analog) ²²
KWGN-DT	34	Can cause interference to KTVD -TV Ch. 20
KCNC-DT	35	Can cause interference to KTVD -TV Ch. 20

Clearly, the ideal situation would be for all stations with adjacent-channel relationships to be co-located on a common site. For example, in the case of KTVD, the proposal to move its (analog and digital) facilities from Mt. Morrison to the common site would minimize some interference relationships with DTV stations on adjacent channels.

This adjacent-channel issue takes on new complexity when it is proposed to relocate some facilities to a new site. For example, in this case of the LCG project, it should be noted that channels 14 / 15 (KTVD at Mt. Morrison) and channel 34 (KWGN-DT) are not presently part of the consortium and will remain at their present sites based on currently available information. Thus, moving the DTV facilities away from the FCC assigned location at Lookout would create an adjacent-channel issue between KWGN-DT and KCNC-DT a condition that is not a concern if these facilities remain at Lookout Mountain. In summary, the greater the separation between the sites of the adjacent-channel facilities, the more significant the interference problems will be.

²² Station KTVD-TV operates on Channel 14 from Mt. Morrison. Its companion DTV facility would operate on Channel 15.

Finally, the last significant co-location issue is that of viewer receiving antenna orientation. It is clear from early industry testing that use of "outdoor" antennas will be desirable, if not necessary, for DTV reception ^{13/}. Equally clear from testing is the fact that antenna orientation is critical and improperly "aimed" antennas will not permit the reception of DTV signals; the acceptable accuracy of antenna pointing may be less than 10 degrees depending on the amount and severity of multipath propagation present. Co-location can eliminate these problems ^{14/}. If DTV signals originate from multiple locations and if these locations also differ from present analog transmission sites, viewers will be further confused in antenna orientation issues.

This is not a significant problem in present analog service because the analog signal is robust and not subject to total failure in the presence of multipath signals. (Multipath appears as "ghosts" in the analog signal - disturbing but not necessarily preventing use by the viewers.) However, in the DTV realm, this multipath can be totally disruptive because of the "cliff-edge" effect wherein the DTV signal can transition from "perfect picture" receivability to a "no picture" status with very small changes in signal characteristics.

Other Service & Interference Issues

Relocating any broadcast facility raises numerous technical issues not the least of which are service provided to the public and interference to other stations, as discussed above; service to the public is typically maximized by appropriate siting of the station and by choice of operating parameters (power and antenna height) which yield the greatest coverage (area and population); however, the freedom to select sites and operating parameters is constrained by the FCC Rules and Regulations which are based primarily on consideration of interference to other stations.

^{13/} This is due to multipath signal propagation caused by signal reflections from large surfaces as described in a later section of this report; this is also prevalent with "indoor" receiving antennas.

^{14/} Viewers wishing to sample program offerings ("channel surfing") would be frustrated by having to re-orient the receiving antenna every time a new channel was selected.

Achieving maximum coverage is as dependent on antenna height as operating power. The subject broadcast VHF / UHF services require basic line-of-sight propagation conditions between transmitter and receiver (as compared with AM broadcasting whose local coverage is determined by ground-wave propagation and relatively unaffected by terrain obstructions). Thus, the higher the effective antenna height, the greater the coverage area and the better the service within that area. Achieving tall tower heights is constrained not only by local zoning and code requirements but also by aeronautical impact as determined by the FAA. The heights usually needed by TV broadcasters (1,000 feet above ground or higher) typically require grants of variances from local ordinances. FAA "approval"^{15/} is required for any structure over 500 feet above ground; myriad factors govern approval of heights above 500 feet including proximity to airports, airways and approach / departure airspace. These FAA-related matters are governed by the FAA's Terminal Instrument Procedures Manual (TERPS) which defines required obstruction clearances for various aeronautical operations. It has been used in considering the aeronautical impact of any proposed construction for the purposes of this report.

The FAA is also concerned about electromagnetic interference to its navigation and communications facilities from high-powered broadcast stations. This particularly impacts the siting of FM stations (since the FM band is very close to the aeronautical bands in the radio frequency spectrum) but the effects of VHF and UHF TV facilities are also considered. It is unlikely that any mass relocation of FM facilities to a new site east of the foothills would be compatible with the FAA's interference requirements relative to existing VHF omni-range (VOR) navigation stations and the Instrument Landing Systems (ILS) serving DIA and Jefferson County airports^{16/}.

^{15/} The FAA does not approve or disapprove proposed structures. It determines whether a substantial adverse aeronautical hazard would be created and issues a "Determination". A "Determination of Hazard" would preclude the FCC from issuing a construction permit for the proposed facility.

^{16/} Some of the present FM facilities on Lookout Mountain could not be constructed today because they would violate the FAA's interference criteria as determined by Airspace Analysis Model (AAM 5.0). In the past, before better immunity from interference was achieved in airborne receivers, pilots referred to the Lookout Mountain FM site as "sing-along hill" because of musical interference in their communications receivers.

As noted above, the FCC also places constraints on relocation which are related to interference. Signal interference results in a loss of service to the affected station. The FCC controls inter-station interference between / among VHF and UHF TV analog stations by specifying separation distances between stations operating on the same and adjacent ¹²⁷ channels; in addition, the FCC has established criteria for interference to digital stations from analog stations. All these criteria must be complied-with in any contemplated station relocation.

For the new digital stations, the FCC has established interference standards instead of fixed distance separations between other analog and digital TV stations. Thus, complex interference calculations must be performed to determine whether the interference requirements would be met if any changes are made in the allotment parameters (i.e., location, power, antenna height). The FCC rules permit a slight amount of new interference to be caused ¹²⁸ in most cases. These studies were conducted for all proposed sites and the results are incorporated in the reports for each site ¹²⁹

¹²⁷ For UHF stations, the "adjacencies" include 9 channels (not contiguous) on each side of the subject channel for a total of 18 channels (in addition to the co-channel) which may be impacted.

¹²⁸ The FCC has determined that any increase in interference caused by a DTV station affecting 2% (or less of the population) is de minimis and, therefore, permissible.

¹²⁹ Such as the requirement to use a directional antenna to protect another station.

Shadowing Mitigation

It has been suggested that the use of translators or repeaters will solve shadowing problems associated with some sites other than Lookout (for example, the severe shadowing that would exist in Boulder and near the foothills from a site such as Squaw Mountain).

Translators are devices that receive an off-air signal from the parent, originating station and re-transmit the signals on a different channel (hence, translation) into areas shadowed by terrain from the originating station. Translators are typically sited on higher terrain providing line-of-sight to the shadowed area and operate at relatively low power levels.

Repeaters or boosters operate on the same principle as a translator except that the signal is re-transmitted on the same channel / frequency as the parent station. This feature imposes significant technical burdens as further discussed below.

In either case, it must be remembered that repeater and translator stations require sites that are relatively high, with line-of-sight to the area sought to be served. It is assumed that each such site would require appropriate zoning and other local approvals.

Analog Environment - In an analog environment, shadowing of the parent station signal results in viewer reception of a weak signal which is manifested in a snowy or weak picture or the reception of multiple signals which is manifested in multiple images (commonly referred to as "ghosting") or a combination of both problems; in the worst case, the terrain effectively blocks all direct reception of the parent station. In virtually all such cases, the poor reception cannot be cured by the use of a repeater because the repeater station transmission on the same channel may cause interference in areas beyond the shadowed area where both parent and repeated signals would be present. Analog repeaters have only been used where there is virtually a complete absence of the signal of the parent station, such as in Hawaii where island cities are separated by tall mountains. A similar physical environment does not exist in

the geographic areas shown in this report as being shadowed. Hence, the use of repeater stations to "fill-in" the shadowed areas is not a technical solution to resolve the loss in analog service. Also, operating a transmitter (repeater) on the same site as the receiver (necessary to pick-up the signal from the parent) is very problematic because both are tuned to the same frequency (i.e., repeater transmitter will interfere with on-site reception of parent signal).

Translator stations could be used to fill-in unserved areas assuming there are a sufficient number of frequencies available for that purpose. If we assumed that five television stations will operate from the new site, no less than 10 translator frequencies (5 for the analog operations and 5 for the digital operations) and many more could be required to provide complete fill-in. As FCC rules require that the new translators protect the allotted analog and digital television broadcast channels as well as existing translator and lower power television stations, it is doubtful that a sufficient number of co-located channels could be found to cover all shadowed areas.

Digital Environment - Some industry sources are holding-out the possibility of using on-channel digital repeaters. Theoretically, the digital receiver can operate in a multipath environment (akin to "ghosting" in the analog case) up to a point. An input "equalizer" in the digital receiver effectively cancels the effects of the multipath signals permitting decoding of the digital information; however, the range and amount of correction available is very limited. Field testing to date indicates that the combination of multipath propagation and the presence of both direct and repeater signals may be too great for the receiver to perform properly; at the present time, there is no viable on-channel DTV repeater system operational (except where total terrain isolation exists as in the Hawaii case cited above)⁴⁰. The same comments that apply to analog translators are also applicable to digital translators, i.e., it is unlikely that sufficient spectrum will be available to support the required number of stations.

⁴⁰ A test case was demonstrated in 1999 which repeated the signals of a Washington area DTV station into West Virginia. In this case, mountains provided a virtual total isolation of the parent and repeater and is not a good enough example for the Denver situation.

Reflections from Terrain

Transmitted radio frequency energy (RF) can be reflected by obstructions in its path of propagation to a receiver. The intensity of the reflected energy is affected by the characteristics of the reflecting surface including its area, surface material properties and angle of incidence of the RF to the surface; the wavelength of the RF energy and its polarization also affect the reflection equation. Suffice it to say that large reflecting surfaces, such as the side of a prominent hill or mountain, will reflect very high levels of RF energy at UHF frequencies. Whether this reflected energy significantly impacts the reception of signals depends on yet another set of factors including: the distance from the reflection point to the receiver, the geometry of the reflection path, the type of receiving antenna in use and several other parameters.

In the present analog TV world, the reflections appear as "ghosts", that is, displaced images in the picture; multiple images, or ghosts, can appear when there are multiple reflecting surfaces. The amount of displacement of the ghost image on the TV screen is a function of the amount of time delay the reflected signal experiences reaching the receiver (relative to the already received signal), the displacement is due to the longer path between the transmitter and reflection point plus the additional length of the path between the reflection point and the receiver. The subjective visual impact of these ghosts is directly proportional to the strength of the reflected signal, vis-a-vis the desired direct signal, and the amount of delay; in a very few analog cases, this can be severe enough to render the signal (picture) unusable.

In the digital realm, the effect is somewhat different; the receiver must deliver a near-perfect signal to its digital decoder in order for it to perform properly. Therefore, the receiver input circuitry includes an equalizer which corrects for distortions such as "ghosts". (The reflected energy is more properly referred to as multipath propagation because the reflected signal in digital applications does not appear as a "ghost" but, rather, it creates unacceptable

distortion of the digital signal.) The amount of correction available in the equalizer is limited and, if the distortion due to multipath is out of its range, the receiver will be unable to decode the signal; at the end of its range, the receiver operability ceases abruptly leading to classification of the "cliff edge" failure.

Industry DTV field testing to date has shown that multipath propagation effects are the number one cause of signal reception failure. Some multipath distortion (due to normal objects between the receiver and the transmitter) is unavoidable; however, such distortions can use a large portion of the available correction capability leaving little or no capacity to correct for abnormal reflections from large objects (e.g., buildings, high terrain) resulting in the inability of the receiver to decode the digital signal.

In the Denver scenario, signals from any transmitter site east of the Front Range foothills will be subject to additional and significant distortion from reflected energy from these hills, particularly at receiving locations close to the foothills.

Thus, while the ghosting may be tolerable in analog reception because the viewer will still be able (up to a point) to use the visual image, in DTV the distortion may result in "cliff-edge" effects where the digital signal (presented on the viewer's TV screen) transitions very rapidly from a situation of a perfect-picture to a no-picture (no reception) condition. This disturbing effect mandates that the broadcaster deliver the best possible signal to the viewer - which can only be achieved by near line-of-sight conditions, adequate signal strength and lack of severe multipath propagation.

End of Transition

The FCC established a timetable for TV stations to convert to digital television operations. This schedule requires commercial network affiliates to begin digital transmission by November, 1999, and for all presently-authorized analog operations to cease in 2006. This period of dual analog and digital operation is referred to as the transition period. The FCC,

under Congressional mandate, is fully expecting to have either the present channel or the DTV channel "returned" by the broadcasters so that the spectrum can be auctioned-off in a Federal budget-balancing maneuver.

Nevertheless, there is a high probability that stations – most of which have facilities in other services installed (e.g., "two-way" radio, microwave relay, cellular or other wireless services) on their towers – will maintain this vertical real estate as a precious commodity. Thus, it would be inappropriate to assume that construction of new digital television facilities will mean that the existing analog towers will be removed soon, or ever, unless done voluntarily as part of a consolidation plan. This would also be true if a consolidation of DTV facilities occurred at a site other than the present site of the analog facilities and the analog facilities could not be practically relocated.

Radio Frequency Radiation (RFR)

RFR is the non-ionizing radiation emitted by any source of radio frequency energy, ranging from cell phones to high power broadcast facilities. The FCC, in compliance with the Congressional mandate to implement the National Environmental Protection Act of 1969, has adopted exposure standards which are codified in 47 CFR 1.1306. These regulations specify the maximum exposure for humans at frequencies throughout the radio spectrum. The limits or Maximum Permissible Exposure (MPE) are further classified for occupational (controlled) and public (uncontrolled) environments. The amount of radiation to which a person might be exposed is determined by many technical factors related to the source characteristics, the most significant of which are the effective radiated power, the height of the radiator (antenna) and the radiation pattern. Of these factors, it is notable that the distance between the source and the person has the greatest effect on RFR levels most since the level varies (inversely) as the square of the separation distance (e.g., doubling the distance reduces RFR to one quarter). Next, the pattern of FM / TV broadcast antennas is such that most of the energy is "beamed" or directed at the horizon rather than up or down. This means that the

ground level energy directly below an antenna will be many times lower than for points at a greater distance which are within the "main beam" area of the antenna pattern ^{21/}; for the UHF DTV antennas, this factor is typically in the order of 500:1 (that is, the energy density directly under the antenna is 500 times lower than the maximum in the "main beam"). Thus, in planning a site so as to minimize ground level radiation, the objective is to place such antennas as high as possible. A related matter comes into consideration when the tower site is in close proximity to high terrain (or tall buildings) such that members of the public at such locations would be exposed to higher radiation because of their elevated positions. In these cases, the distance between the source (antennas) and the potentially affected person is the important criterion. As noted above, the RFR decreases as the square of the distance so that the RFR level at a distance of five miles is 697 times lower (0.14%) of the RFR at 1,000 feet from the tower. Thus, even though a location may be in the "main beam" due to terrain factors, the RFR will be greatly reduced due to distance; in any event, these levels must be less than the federally and locally imposed limits.

The FCC regulations provide a public exposure limit that is one-fifth (20%) of the allowable occupational exposure; it is estimated that this provides a safety factor ^{22/} of approximately 500:1 for public exposure. Jefferson County has adopted standards similar to the FCC requirements (in fact, they are exactly the same at the frequencies of interest) and LCG proposes to comply with a large margin ^{23/}.

^{21/} However, for some existing FM antennas and older design TV antennas, this may not be as true. Modern antennas can be designed to minimize downward radiation.

^{22/} Relative to the threshold level where effects of exposure to RFR are first noted in scientific studies.

^{23/} In fact, the LCG proposal for Lookout Mountain would reduce overall RFR from current levels and provide an environment where the RFR is typically less than 1% of the regulatory limit.

SITES CONSIDERED

- Locations East of Foothills

- Mountain Sites (Developed)
 - Lookout Mountain
 - Squaw Mountain
 - Colorado Mountain
 - Mt. Morrison
 - Green Mountain

- Undeveloped Sites ^{28/}
 - Site A
 - Site B
 - Site C
 - Site D
 - Site E
 - Site F
 - Site G

^{28/} These sites are all generally west of the Lookout Mountain site and are not identified in this report by exact location or ownership status because of confidentiality concerns. Suffice it to say that the sites were initially identified because of the ground elevation, apparent lack of development and preliminary assessment of other desirability / suitability factors.

Locations East of Foothills

Any site in the high terrain of the foothills has the advantage of a ground elevation that is significantly higher than the low, flat terrain to the East. For example, the terrain elevation in central Denver is approximately 5,200 feet above sea level while the elevation at the Lookout Mountain site is 7,260 feet or approximately 2,000 feet above the typical terrain elevation to the East; this, coupled with the proposed tower height, yields a height of 8,150 feet above mean sea level, would place most of the broadcast antennas approximately 2,900 feet above the terrain to the East.

Television broadcasting and FM broadcasting operates in frequency bands where line-of-sight is the predominant mode of signal propagation; this is particularly true of the UHF channels allotted by the FCC for Digital Television broadcasting in the Denver area. Furthermore, to date, industry testing of the new DTV signals in real-world reception scenarios reinforces the desirability of having near-line-of-sight conditions between transmitter and receiver in order to have acceptable signal reception. Finally, the FCC coverage predictions are based on the station power and effective antenna height with height above ground being the predominant factor which determines actual coverage. Therefore, antenna height is a very significant factor in site selection.

Because of the rising terrain to the West, coupled with decreasing population density in this direction, the primary service areas for the broadcasters are to the East. In order to match the coverage area achievable with the facilities assigned by the FCC, a station operating east of the foothills would have to have a tower 2,500-2,800 feet in height (depending upon actual ground elevation at the site) to match the Lookout Mountain antenna height. Towers over 2,000 feet are generally not permitted by the FAA and the FCC^{25/}.

^{25/} There are a few towers slightly over 2,000 feet high (e.g., 2,049 feet) primarily located in the plains of Iowa and the Dakotas. There are none over 2,100 feet and special permission is required from both the FAA and the FCC for structures over 2,000 feet.

The principal constraint, however, on the construction of a tall tower will be the local utilization for aeronautical purposes of the navigable airspace. Figure 1 is a copy of the local aeronautical chart which depicts the present airspace utilization; most significantly, there are no existing man-made structures which exceed 750 feet above ground within 30 miles of Lookout Mountain or 25 miles of central Denver ^{25/}. Most of the protected airspace is related to the numerous public-use airports in the Denver metro area including ^{22/}:

Aurora
Jefferson County (BJC)
Centennial (ARA)
Front Range (FTG)
Boulder
Tri-County

Of course, to the East of Denver, DIA (DEN, in FAA nomenclature) totally impacts the airspace greatly restricting the ability to construct any tower in a very large area. For example, the maximum height in the vicinity of the old Stapleton Airport would be limited to approximately 800 feet which is far short of the height required to achieve the coverage presently obtained by the FCC authorized facilities (which coverage served as the basis for the FCC's coverage replication process in the implementation of DTV). Tower height in this area will be affected by:

- instrument approaches to Denver International (landing to the East);
- departure procedures from Denver (West take-offs);
- Minimum Vectoring Altitude.

^{25/} Sites beyond 25 miles from the center of Denver would be unacceptable because of the inability to provide very strong signals over the urban area to assure ease of reception.

^{22/} There are numerous private (non-public use) airports in the Denver area which are not entitled to protection under FAR 77 but may seek protection through local zoning processes. In addition, Buckley Air National Guard Base southeast of the former Stapleton Airport is entitled to protection under Part 77.

Complying with all existing FAA criteria would appear to limit the height of any structure to 6,049 Ft. AMSL or 800 ft. AGL in the vicinity of Stapleton. Location of any VHF TV facilities (particularly channels 2, 4, or 6) or FM facilities at such a site would raise FAA concerns about interference (RFI) to the ILS Localizer serving Runway 7 at Denver (see Footnote 22 below).

Inspection of Figure 1 will reveal that the only tall tower within 30 miles of Denver is the structure located near Frederick ^{28/} which is 1,161 feet above ground (but "only" 6,249 feet above sea level -- compared to the 8,150 ft. elevation at Lookout). A detailed analysis has been conducted to determine where a tall tower could be constructed east of the foothills in light of FAA restrictions. The results of these studies (which applied FAR 77 and TERPS criteria) reveal that no tall tower can be constructed in the area bounded by the dashed line shown on Figure 1 (which is approximately 30 miles from Denver) without having a significant aeronautical impact; such impacts, if deemed to have a "significant adverse effect on the safe and efficient use of the navigable airspace" by the FAA, will merit a "Determination of Hazard to Air Navigation" from that agency. The FCC will not grant construction authority to any broadcast station absent a concurrence from the FAA on airspace impact ^{29/}.

Towers much above 1,100 feet would be problematic (in either northern or southern areas) until north of a Longmont to Ft. Morgan line or south of an East-West line through Waterton (Latitude 39° - 30' North, approximately). Any sites would have to be at least 15 miles from DIA for consideration for tall tower implementation.

^{28/} KDEN, Longmont, which is sited about 28 miles from downtown Denver.

^{29/} There are also FAA concerns regarding possible interference (RFI) to aeronautical navigation and communications systems which have not been considered here since the physical obstruction aspect will govern. However, relocation of FM stations from Lookout to a site east of the foothills would be very problematic because of predicted RFI to FAA facilities based on the FAA's Aeronautical Analysis Model AAM 5.0. This would particularly impact stations KBPI, KALC, and KRFX because they are at the high end of the FM band adjacent to the aeronautical band.

For the purposes of discussion only²⁰, we have assumed that a 1,000 foot tower could be constructed on the site of the former Stapleton Airport. From such a facility, the coverage for the DTV stations would be predicted to appear as shown in Figure 3 (using FCC methodology); compared with the coverage from Lookout (Figure 2), it can be readily seen that significant service losses would be suffered. The area and population figures for KCNC have been used as an example assuming KCNC could operate with maximum power as authorized by the FCC (1,000 kW); analysis of other stations would yield similar results.

However, in order to assess the feasibility of relocating the DTV facilities to a site on the east-side of Denver, it is necessary to study – in addition to the FAA obstruction and interference issues – the potential for interference that might be caused to other analog and DTV stations in accordance with FCC-established protocols. The DTV facilities of each of the following stations were studied in terms of relocating to the Stapleton site: KCNC-DT, KRMA-DT, KMGH-DT, KUSA-DT, KTVD-TV and KTVD-DT. The service data for KCNC-DT at the new site after power adjustment vis-a-vis KCNC-TV coverage at present site Lookout Mountain is as follows:

	<u>Area (sq. km)</u>	<u>Population</u>
KCNC-TV	40,890	2,623,770
KCNC-DT	<u>24,223</u>	<u>2,158,029</u>
difference (loss)	(16,677)	(465,741)
% (loss)	(40.8%)	(17.8%)

²⁰ As noted in earlier discussion, there are aeronautical obstruction and RFI issues which would appear to prevent construction of such a tower at this location.

In the table below, it is clear that the interference issue will cause significant reduction in operating power levels for most stations. For example,

	<u>Allotted</u>	<u>Max. Permissible Power</u> ^{31/}
KCNC-DT	1,000 kW	250 kW
KRMA-DT	1,000 kW	150 kW
KUSA-DT	1,000 kW	1,000 kW
KMGH	1,000 kW	400 kW
KTVD	1,000 kW *	25 kW

* From FCC Application

The results of the study indicate that only KUSA-DT could be constructed at this site while retaining its FCC allotted power because of interference considerations. The other stations would have to reduce power in order to protect adjacent-channel stations. KRMA-DT, for example, would have to reduce its power to 150 kW and KTVD-DT would be reduced to 25 kW^{32/}. Table 1, attached, summarizes the required power reductions and the attendant loss of coverage and service to the public from a hypothetical Stapleton site^{33/}. It is clear that significant losses in area and population would result for all stations except KUSA.

^{31/} The maximum permissible power as determined by FCC interference requirements.

^{32/} Based on use of an omnidirectional antenna.

^{33/} The methodologies employed include both "FCC" for general coverage evaluation and Longley-Rice ("LR") which provides a more accurate evaluation based on consideration of terrain effects. The FCC has adopted the LR methodology for DTV because it claims that it is a better predictor of service due to the manner in which it treats terrain variations which adversely impact signal propagation.



Table 1

Lookout Mountain vs. Stapleton Site
AREA AND POPULATION SERVICE COMPARISON SUMMARIES

	<u>AREA</u>		<u>POPULATION</u>	
	<u>FCC</u> (Sq. km)	<u>LR</u> (Sq. km)	<u>FCC</u>	<u>LR</u>
KTVD-DT				
<u>1000 kW Lookout Mountain</u>	35087.2	35040.1	2,570,339	2,299,064
<u>25 kW Omni New Site</u>	16591.2	20584.6	2,039,974	2,142,735
Difference:	18496.0	14455.5	530,365	156,329
Percent of Lookout Mountain:	47.29	58.75	79.37	93.2
Percent Difference:	52.71	41.25	20.63	6.8
KUSA-DT				
<u>1000 kW Lookout Mountain</u>	35087.2	35337.2	2,570,339	2,306,129
<u>1000 kW Omni New Site</u>	31178.9	31353.2	2,267,347	2,201,265
Difference:	3908.3	3984.0	302,992	104,864
Percent of Lookout Mountain:	88.88	88.73	88.21	95.45
Percent Difference:	11.14	11.27	11.79	4.55
KMGH-DT				
<u>1000 kW Lookout Mountain</u>	35087.2	35246.9	2,570,339	2,304,573
<u>400 kW Omni New Site</u>	26341.4	28337.2	2,199,520	2,173,325
Difference:	8745.8	6909.7	370,819	131,248
Percent of Lookout Mountain:	75.07	80.40	85.57	94.30
Percent Difference:	24.93	19.60	14.43	5.70
KCNC-DT				
<u>1000 kW Lookout Mountain</u>	35087.2	33715.2	2,570,339	2,282,810
<u>250 kW Omni New Site</u>	24223.4	25750.0	2,182,776	2,158,029
Difference:	10863.8	7965.2	387,563	124,781
Percent of Lookout Mountain:	69.04	76.38	84.92	94.53
Percent Difference:	30.96	23.62	15.08	5.47
KRMA-DT				
<u>1000 kW Lookout Mountain</u>	35087.2	35137.9	2,570,339	2,302,469
<u>150 kW Omni New Site</u>	22188.2	25094.7	2,120,671	2,158,218
Difference:	12899.0	10043.2	449,668	144,251
Percent of Lookout Mountain:	63.24	71.42	82.51	93.73
Percent Difference:	36.76	28.58	17.49	6.27
KCNC-TV Licensed Facility				
<u>KCNC-TV Licensed Facility</u>	40890.4	39029.3	2,629,770	2,345,413
<u>KCNC-DT at Lookout Mountain</u>	35087.2	33715.2	2,570,339	2,282,810
Difference:	5803.2	5314.1	59,431	62,603
Percent of Licensed Facility	85.18	86.38	97.97	97.33
Percent Difference:	14.82	13.62	2.03	2.67

Another factor which would need further investigation is the possibility of significant reflected energy from the lower foothills affecting reception in the Denver and Boulder areas; these reflections, which would appear as "ghosts" in the present analog TV service, could have a destructive impact on digital television transmission, particularly for receiving locations on the west side of the city as discussed earlier in this report.

As noted above, an existing tall tower near Frederick establishes a benchmark for FAA obstruction purposes. This is the only tall tower (1,161 feet AGL, 6,249 feet AMSL) in the vicinity of Denver ^{24/}. It is identified with KDEN Longmont which has a construction permit for operation on Channel 25. Also, KCKK-FM is authorized to operate from this site. A taller tower would penetrate the procedure turn ^{25/} surface associated with the VOR-A instrument approach to Tri-County Airport near Lafayette and, in fact, the present tower establishes the procedure turn altitude of 7,200 feet (1,000 ft. clearance above the obstacle). Any height increase could be accomplished only with an increase in the procedure turn altitude; the prime concern in this case would be the required maximum aircraft rate-of-descent (or descent gradient) on final approach. The procedural altitude could be raised about 300 feet while keeping the gradient within FAA preferred limits; this translates to a tower height of approximately 6,405 feet AMSL (6,249 feet is a possibility).

Another anomaly is the fact that the area where the tower is located underlies Victor Airway V-575 (from Mile High VOR to the Northwest) where the minimum enroute altitude is 8,000 feet; since this airspace is designated as being in "mountainous terrain" by the FAA, there is normally a 2,000 ft. buffer under the airway. However, this is being "violated" by the present tower as the maximum height would be limited to 6,049 feet if this criterion had been applied.

^{24/} A tower 985 Feet AGL / 6,165 feet AMSL is located 6.5 miles southwest.

^{25/} A course reversal maneuver that is part of the instrument approach procedure.

Moving the tower site about 3 miles east would remove it from consideration in terms of the approach to Tri-County Airport and could permit a height increase up to 2,000 feet AGL (about 6,949 feet AMSL) assuming that the "mountainous terrain" adjustment does not apply in this case.

However, such a move would place the structure underneath a sector of the Denver International Class B airspace which has a floor of 7,000 feet. The minimum vectoring altitude (MVA) in this area is 7,000 ^{26f} feet presently. This would require establishment of an area 3 miles in radius (centered on the tower site) with an MVA of 8,000 feet which could create operational problems for arriving / departing traffic from Denver International. *This is probably the most significant aeronautical problem.* It is likely that the FAA would resist any proposal to increase the MVA above 7,000 feet ^{27f} meaning that any tower height above 6,049 feet AMSL (a tower of 1,000 ft. or less in most locations) would not be approved. In order to "clear" these problems, a move in the direction of Platteville would be required. All things considered, it is not likely that a tower much taller than 1,000 feet AGL would be approved in the northwest quadrant within 25 miles of the Denver International Airport, that is, a tall structure in this area would have to be at least 25 miles northwest of DIA (DEN).

A tower built in this area for DTV station use would be problematic and undesirable because of several technical factors including:

- the distance to the south end of the metropolitan area is nearly 40 miles compromising coverage / service to this area;
- while good line-of-sight conditions to Boulder exist, a significant terrain reflection issue would arise;

^{26f} The MVA is generally 7,000 feet in this area except that it is 7,200 feet within 3 miles of the existing Frederick tower.

^{27f} Any increase above 7,000 feet results in the loss of a "cardinal altitude" (e.g., 6000, 7000, 8000, 9000, etc.) and creates ATC issues regarding the safe and efficient use of the airspace.

- locating any FM facilities on this site would be doubtful because of interference (RFI) to FAA navigation facilities^{38/};
- the distance to the Table Mountain Receiving Zone would be similar to the distance from Lookout but the position of DOC / NIST regarding use of a new site would require re-approval and granting of waivers of existing rules under "grandfathering" provisions;
- Channel 4, KCNC, cannot move its NTSC to a site in this area without an FCC waiver because of a short-spacing to a co-channel station in Scottsbluff, NE;
- the coverage from an antenna at 1,500 ft. AGL / 6,600 ft. (approx.) AMSL will not compare favorably with a Lookout facility at 8,100 ft AMSL;
- DTV interference issues, as with the Stapleton hypothetical site, would require significant DTV power reductions;
- receiving antenna orientation issues will be a significant source of problems for the viewing public.

Developed Sites

Several sites have been previously developed for communications uses in Jefferson and Clear Creek counties. These are discussed below.

Lookout Mountain

This site meets all FCC requirements relative to the siting of FM and DTV facilities. It also has "grandfathering" status relative to Table Mountain protection which can be preserved without further FCC / DOC action.

^{38/} Studies using the FAA's Airspace Analysis Model (AAM 5.0) indicates that many of the FM stations presently sited on Lookout would create unacceptable interference to FAA facilities if relocated east or northeast of the present site.

Coverage of Boulder is much better than from Squaw Mountain and area coverage, as summarized in Table 2, is superior than from any other developed site.

At least two existing towers would be immediately removed through consolidation in the transition process thus reducing environmental impact; the third and fourth towers would be removed when analog transmissions cease.

The existing RFR situation will be greatly improved because of consolidation of facilities on the tall tower and elimination of relatively low FM antennas presently installed on existing towers.

From a practical, operating perspective, the access to the site from Denver is excellent, abundant power is available and stations maintaining existing facilities on Lookout will enjoy the benefits of having analog and DTV facilities in close proximity.

[Issues relating to zoning and land use are not discussed in this document as these are the subject of on-going litigation between LCG and Jefferson County. The County has granted approval to one station to add its DTV facility to an existing tower apparently on the basis that removal of an existing antenna on the tower would provide structural capacity to accommodate the new antenna without any substantial changes to the existing tower.]

Squaw Mountain

While Squaw Mountain offers a much higher effective antenna height, it is also the farthest site from the Denver metro area. A significant portion of the potential signal improvements attendant to the elevated site would be spent covering very sparsely populated areas between the site and the beginning of the more densely populated areas at the foot of the Front Range mountains. This is not an efficient distribution of power / coverage.

**DTV SERVICE FROM LOOKOUT MOUNTAIN & SQUAW MOUNTAIN**

Principal Counties	Lookout Mountain	Squaw Mountain	Δ *
	LR50,90	LR50,90	
Denver	467,610	467,610	0
Jefferson	435,336	431,791	-3,545
Arapahoe	391,498	391,505	0
Adams	265,027	265,038	0
Boulder	219,823	123,112	-96,711
Larimer	175,102	144,529	-30,573
Weld	131,551	130,774	777
Douglas	59,952	58,545	-1,407
		Total	131,459

* Δ = difference

Summary

Loss of service to 131,459 people in principal counties

Loss of service to 96,711 people in Boulder County (43% of population)

The effective signal strength over Denver from Squaw Mountain will actually be less than from any of the other developed sites because of its much greater distance from the center of the population.

The principal technical disadvantage of the Squaw Mountain site is the vastly inferior service that would be rendered to Boulder residents and others close to the foot of the mountains. This deficiency is caused by terrain shadowing which obstructs the line-of-sight path between the transmitter and the viewers in these areas. This is reflected in the population / service summaries in Table 2.

While the signal levels from Squaw Mountain over the Table Mountain facility would be arguably lower than those from any of the other sites, there are unsettled issues related to the status of "grandfathering" of existing facilities on Lookout Mountain should they be relocated to Squaw Mountain but it is likely that these could be favorably resolved.

A further complication arises from constraints imposed by the FCC regarding separation requirements between broadcast facilities operating on the same or adjacent channels and, potentially, by the new constraints imposed relative to DTV facilities. For example, it appears KCNC-TV, Channel 4, could not move its NTSC facility to Squaw Mountain because of a separation problem relative to a co-channel station in Grand Junction, CO; it would be 31 km (20 miles) too close to that station. While a waiver of the FCC requirement could be sought, there is no guarantee it would be granted. This would then require that KCNC maintain its present operations at Lookout Mountain while also operating a DTV facility at Squaw Mountain. Furthermore, it appears that KCFR might have FCC constraints because of an adjacent-channel station in Vail if it were to be relocated to Squaw Mountain. Both KCFR and KUVU would lose service area (coverage) by moving to Squaw Mountain. As noted earlier, it is also essential that these FM stations be co-located with KRMA, Channel 6, because of interference considerations. Thus, KRMA, Channel 6 would be constrained from moving to Squaw Mountain assuming the problems related to the FM stations controlled their

relocation; then it, too, would have to maintain its present analog operation at Lookout Mountain but its DTV facility would have to move with the other DTV facilities (KUSA, KMGH, KTVD) to Squaw Mountain because of adjacent channel interference concerns. Thus, its present tower on Lookout Mountain, which would be dismantled under the Lake Cedar proposal, would have to remain. From an operational point-of-view, having to maintain two widely separated facilities will impose significant cost and personnel burdens on the stations.

Finally, it is our understanding that the Squaw Mountain tower would only be 250 feet high. This causes concerns regarding ground level radiation since the antennas would be very close to the ground at this site.

All things considered, Squaw Mountain is not a good site for a DTV build-out, especially when compared to the other available sites.

Eldorado Mountain

This site solves the problem associated with Squaw Mountain of "shadowing" of the Boulder area since it is located farther north and is not encumbered by the close-in terrain which "shadows" Boulder from Squaw Mountain.

Relocating the non-commercial FM stations to this site is problematic, at best, for reasons similar to those discussed above relative to Squaw Mountain, thus, precluding the relocation of Channel 6 from Lookout Mountain. The commercial FM station relocations would be challenged by numerous interference constraints – resulting in reductions of power (and, consequently, reduction of service areas) in order to protect other stations.

The Table Mountain issues are greatly magnified in any operation from Eldorado because the site is much closer to the Receiving Zone than any of the other sites considered and grandfathering provisions will not apply to the FM stations or any relocating analog TV station; the DTV exemption for Table Mountain protection only applies to the allotment site (i.e., Lookout Mountain)^{39/}.

Mt. Morrison

The principal technical issues at Mt. Morrison would be the terrain shadowing of Boulder (slightly worse than from Lookout Mountain) and ground level RFR due to the short tower and surrounding high terrain where public exposure is a problem. The "grandfathering" status relative to Table Mountain for each station could also be an issue, but since this site is slightly farther away from Table Mountain DOC / FCC would likely extend the grandfathering.

A height increase of approximately 250 feet above the present tower height (total height approximately 600 feet above ground) would be required to match the service from Lookout Mountain (and mitigate the RFR concerns). At the present time, Jefferson County has rejected a proposal for DTV build-out on this site.

^{39/} The proposed DTV facilities at Lookout Mountain would arguably violate the FCC protection requirements for Table Mountain. Through numerous meetings and data exchanges with the NLR and the Department of Commerce / NIST, the DOC withdrew its objections to the proposed LCG DTV construction by "grandfathering" all DTV allotments at Lookout Mountain. This "approval" does not extend to any other sites as any relocations will require new approvals if the regulatory baseline protection requirements would be exceeded.

Green Mountain

Green Mountain reportedly has some minimal development for use in communications applications. It would be an acceptable location from a coverage standpoint with a structure in the order of 1,200 ft. (AGL) high. However, a VFR "Flyway" (southbound), designed to have VFR aircraft avoid the western boundary of the Denver Class B airspace, is charted at an altitude of 8,500 ft. (AMSL). Any structure sited here over 700 ft. high will "draw fire" from the FAA and local airport / pilot groups because it would not permit the "normal" 1,000 ft. obstacle clearance for aircraft traversing the flyway without penetrating the outer areas of the Denver Class B airspace.

It is unlikely that this would be an acceptable site due to the high visibility of the tower and the residential nature of the surrounding areas. Radio frequency radiation concerns may be an issue for residential areas to the West, although predicted RFR levels would be well below the maximum permissible levels they would be higher than levels calculated for Lookout Mountain which were challenged by local groups as being too high.

Undeveloped Sites

Several presently undeveloped sites have been identified in the mountainous terrain west of the present Lookout Mountain site. These sites were selected for further review / ranking based on the following criteria:

1. Relatively high elevation with no major terrain obstructions to the east.
2. Removed from any substantial residential development.
3. Not within 5 miles of residential areas on higher terrain (to the West).
4. Proximity to road and utility infrastructure.
5. Compliance with all FCC / FAA requirements; Table Mountain protection compliance.
6. Coverage / service objectives.
7. Analog TV and FM station co-location (desirable to improve RFR situation at Lookout Mountain).
8. Land availability and zoning issues.

It should be noted that all of the undeveloped sites discussed are in Jefferson County and none meet the County's criteria to be classified as a developed existing communication site. The site comparison table which follows evaluates all sites on the basis of a rating scale considering all of these above factors and others. "Site D" appears to be the optimum undeveloped location.

"Site D"

Of all the undeveloped sites reviewed, "Site D" offers interesting possibilities as it appears to meet most of the objectives outlined above. However, further investigation is required to completely assess all of the practicalities of developing the site (power and utilities, road access, etc.).

For the purposes of comparing coverage, it was assumed that a tower height equal to that proposed for Lookout Mountain could be constructed on the site (which appears to be possible). The ground elevation at "Site D" is approximately 210 meters (689 feet) higher than the Lookout Mountain site. A comparison of a 1,000 kW facility at each site shows the following results.

County *	Population Served		Δ
	Lookout	Site D	
Adams	265,031	265,038	--
Arapahoe	391,503	391,505	--
Boulder	220,314	201,287	-19,027
Denver	467,610	467,610	--
Douglas	60,044	54,865	-179
El Paso	51,106	33,504	-17,602
Jefferson	436,014	436,049	--
Larimer	175,603	155,422	-20,181
Morgan	21,852	21,900	--
Weld	131,618	131,665	--
Total			-56,989

* Counties having less than 5,000 people served not listed.

Δ = difference ("Site D" vs. Lookout)

This shows a net loss of service to 56,989 persons including 19,027 in Boulder County. A study was conducted to identify specific areas where reception may be difficult due to terrain shadowing and this confirms the loss of service to Boulder and other areas. This loss of population is based on 1990 Census data. However, the Denver Regional Council of Governments (DRCOG) has assembled and published growth data which indicates population increases in Boulder County for affected RSA's (Regional Statistical Areas) 102 through 105 between 1996 and 2020 of 43% (from 253,000 to 361,000. Extrapolating from this data, it can be assumed that the population in shadowed areas will increase by a similar factor or an increase in unserved persons from 56,989 to 81,494.

Thus, "Site D" is a better site than Squaw Mountain but is not as good as Lookout in terms of coverage. [For the purposes of this study, it was assumed that stations on "Site D" could operate with facilities which match the coverage area of the largest facility on Lookout Mountain, i.e., matching the coverage area of KCNC. Based on this assumption, a power of 1,000 kW could be employed even though this would exceed the normal FCC maximum for DTV stations. This power level may be subject to downward adjustment when the FCC clearly defines what constitutes an "area match". However, it is also noted that the antenna height above average terrain will be lower ⁴⁰ from "Site D" than from Lookout Mountain and this bodes well for the use of 1,000 kW.]

Another issue at "Site D" will be the protection of Table Mountain. The site is approximately 5 km closer to the Radio Receiving Zone. Since all calculations relative to permissible fields over the Table Mountain site are based on free-space propagation assumptions, it would be expected that the signal level would increase by 1.0 dB. If NIST insists on a precise power adjustment, this would require a reduction in maximum power to approximately 800 kW or use of a directional antenna to keep the signal at the same level. This subject needs to be explored / negotiated further with NIST but it is likely that NIST will concur with the 1,000 kW based on recent informal discussions.

⁴⁰ Due to FCC calculation methodology.

Acquisition and infrastructure improvement costs are conservatively estimated at \$1,000,000; these are costs which would not be incurred at Lookout Mountain. It is also possible that a taller tower could be used at "Site D" to improve line-of-sight and coverage but a preliminary cost-benefit analysis does not conclude that any substantive improvement could be made.

Summary and Conclusions

From the above analyses it is clear that:

- ① Sites east of the foothills which require construction and use of a new tower will be limited in height by FAA constraints. Operating power would be significantly reduced for most stations because of interference considerations, and, therefore, the service from such facilities would be significantly reduced relative to the FCC allocation / mandate.
- ② Of the presently developed sites only Lookout Mountain has the optimum combination of required characteristics which will allow coverage and service to be maintained with minimum interference.
- ③ Of the undeveloped sites, most do not meet or match service objectives but comply with FCC requirements and have no FAA concerns; however, actual development would involve significant costs to provide access roads, primary power and other utilities, would require negotiation with land owners (availability uncertain) and raise significant zoning approval issues. Of the sites studied, "Site D" appears to be the most promising.
- ④ Sites well to the north and south of the Denver metro area would be plagued with FCC interference issues, would not support FM co-location and, in the end, would result in reduced service (due to the large distances to the metro area, reduced power and reduced height); also, it is unlikely that any existing towers on Lookout Mountain would be removed because of the severely truncated co-location possibilities.

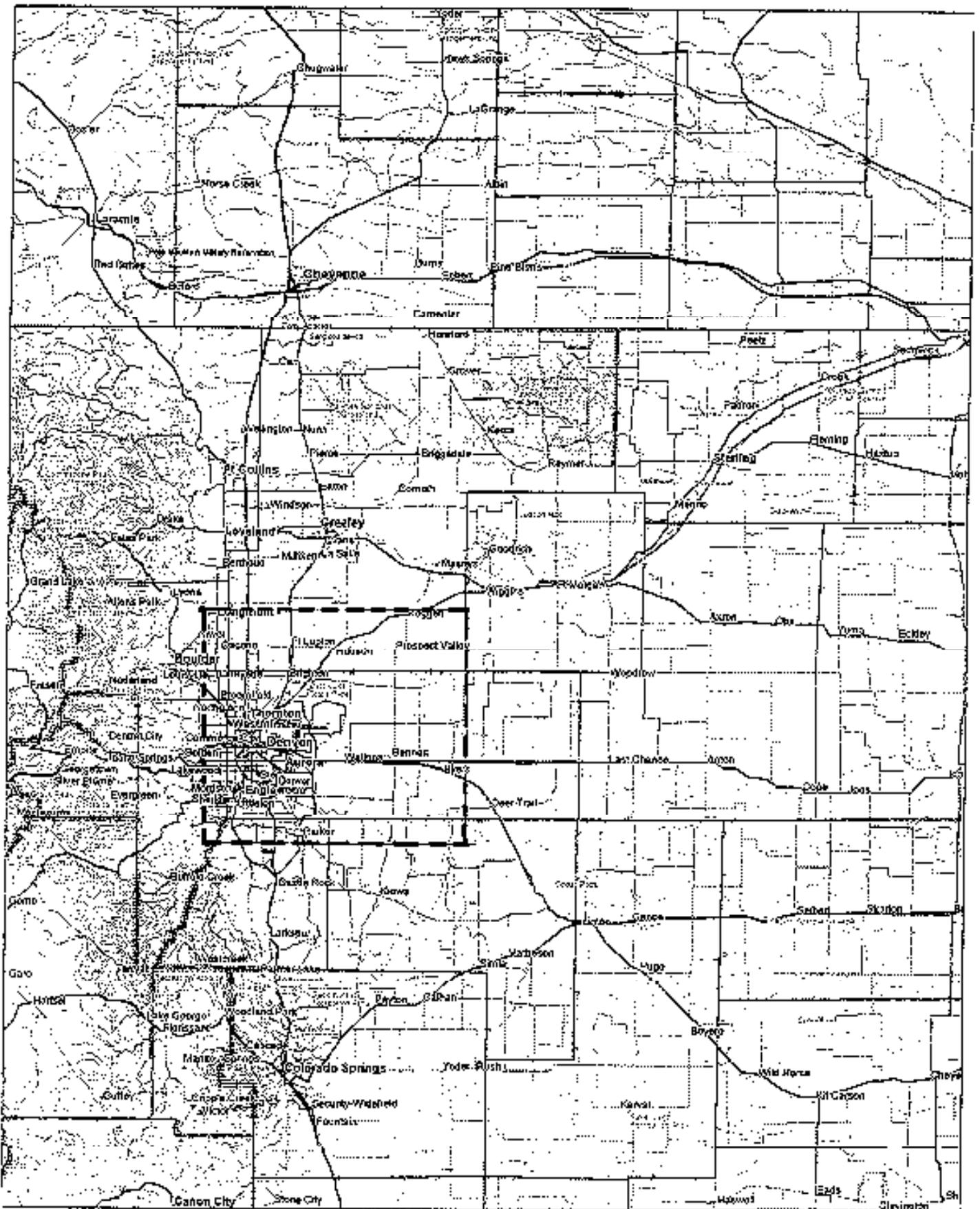
Therefore, in my professional opinion, the Lookout Mountain site is the best site from which the television stations can achieve the service to the public mandated by the Federal Communications Commission and that each of the other sites considered falls short in one or more ways such that, in the aggregate, none compares favorably with Lookout Mountain.

December 31, 1999

IBI

EXHIBIT 1

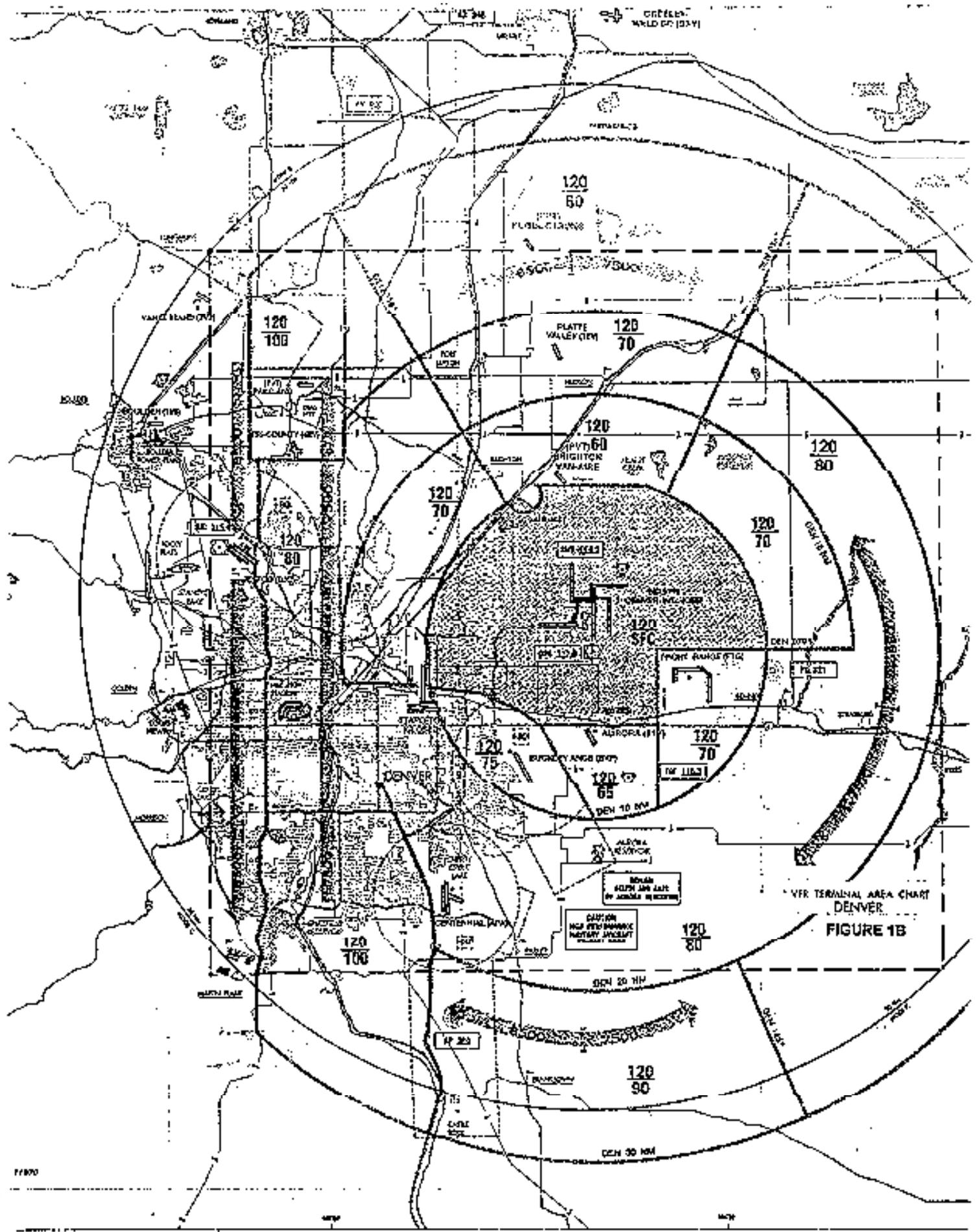
Figures 1 – 3



DENVER AREA

FIGURE 1A

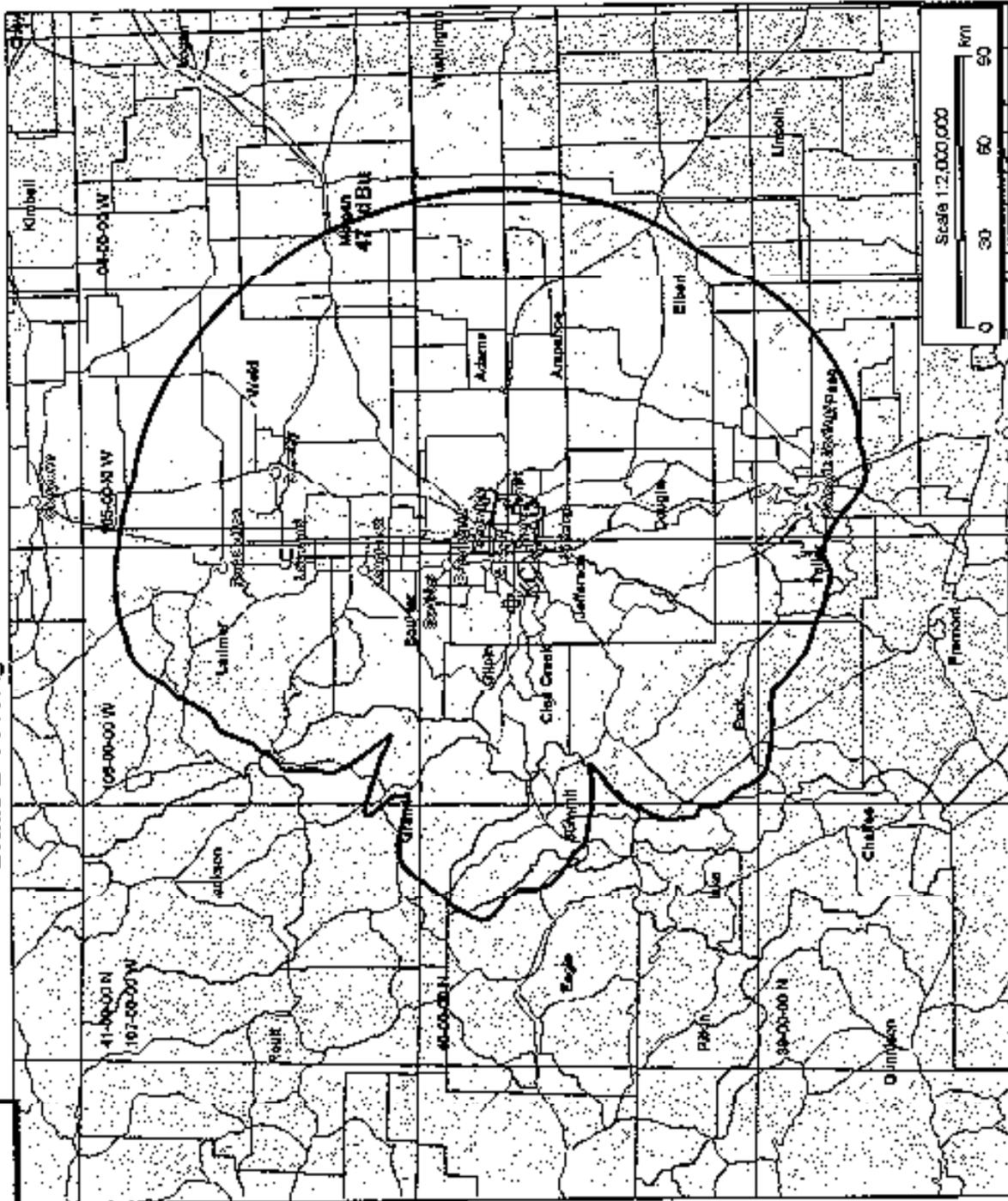
1" = 25 Miles / 1:1,500,000



VFR TERMINAL AREA CHART DENVER. FIGURE 1B

John F.X. Brovne & Associates PC

Grade B Coverage at Licensed Parameters KCNC-TV



KCNC-TV
Latitude: 38-43-48 N
Longitude: 106-14-02 W
Power: 100.00 kW
Frequency: 635 MHz
Channel: 4
AMSL Height: 2462.0 m
Elevation: 219.31 m
Ant: Omni
Prop. Modes: Line of Sight
Climate: Cool temperate
Conductivity: 0.0050
Dielec. Const: 15.0
Refraction: 34.0
Receiver Ht. Ab: 9.1 m
Time Variability: 50.0%
S2 Variability: 50.0%
ITM Mode: Broadcast
Date: 8-22-08

□ >41.0 dBu

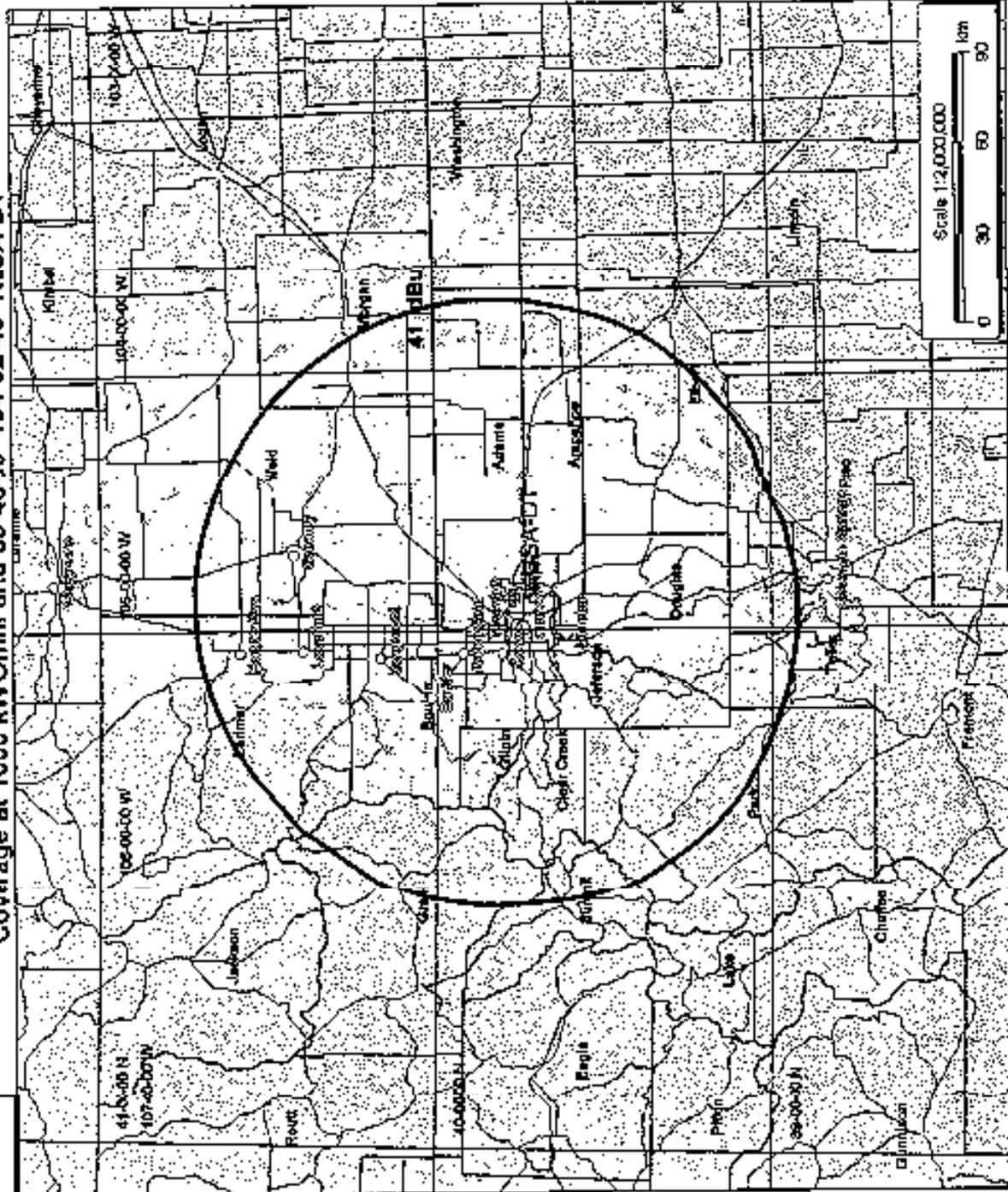
FIGURE 2

John F. X. Browne & Associates PC

Coverage at 1000 kW Omni and 39-46-30 104-52-48 KLSA-DT

KLSA-DT
Latitude: 39-46-30 N
Longitude: 104-52-48 W
Power: 1000.00 RW
Frequency: 435.0 MHz
Channel: 16
Antenn. Height: 195.6 m
Elevation: 1665.0 m
Ant. Omni
Prop. Model: LongleyRice
Climate: Cont. temperate
Conductivity: CCCC
Dielec Const: 15.0
Refractivity: 31.0
Receiver Ht AS: 9.1 m
Time Variability: 50.0%
St. Variability: 50.0%
ITM Mode: Broadcast
Date: 9-23-99

>41.0 dBu



1000 KW AT STAPLETON

FIGURE 3

